

manual change transmittal

NO. TM02-2

TITLE Traffic Manual	APPROVED Jesse Bhullar	DATE ISSUED 9-13-02 PAGE 1 OF 1
SUBJECT AREA Chapter 6, Markings, Section 6-03.2 - Rumble Strips	ISSUING UNIT Traffic Operations Program	
SUPERSEDES Chapter 6, Markings, 7-1996, Pages 15-19.	DISTRIBUTION All Manual Holders	

Attached are revisions to Traffic Manual 6-03.2 - Rumble Strips that were developed as part of a research study on Rumble Strips by the Traffic Safety Research Branch. The attachments replace pages 15-19 in Chapter 6 of the Traffic Manual.

The manual update should be implemented on all new construction and during routine maintenance operations.

ATTENTION: This hard copy version as well as other chapters of the Traffic Manual may not reflect new or revised policies of the Department of Transportation. To get the latest updates to the entire Traffic Manual, see the "Traffic Operations Program Directive and Policy Memos" web page at <<http://www.dot.ca.gov/hq/traffops/signtech/signdel/policy/policy.htm>>.

Special Pavement Treatments 6-03

6-03.1 Advance Markers - Exit Ramps

A 3-2-1 countdown pattern of one-way clear reflective pavement markers may be used to help motorists locate exit ramps in heavy fog areas.

The pattern consists of three markers placed on the right shoulder about 630 m in advance of the neutral area (gore), two markers at about 420 m and one marker at about 210 m. The markers are placed on a line perpendicular to the laneline at 0.3 m spacing beginning 50 mm off the edge of traveled way.

6-03.2 Rumble Strips

Rumble strips are bands of raised material or indentations formed or grooved in the traveled way on the centerline, or shoulders. Rumble strips call the motorist's attention to standard warning or regulatory devices or otherwise alert drivers by transmitting sound and/or vibration through the vehicle.

Rumble strips may be used in the traveled way on California's streets and highways if standard traffic control devices have been thoroughly evaluated and documented and the traffic engineer considers their use as the optimal solution to the identified problem.

Centerline rumble strips may be used on the state highway system. Traffic engineers may consider the use of this low cost improvement in response to observed or potential cross centerline collisions. Types of centerline rumble strips include: barrier strips with raised profile thermoplastic traffic strips, rumble strips (raised or ground in) within centerline buffer zones, surface mounted channelizers on a centerline buffer zone, black raised pavement markers on the centerline, etc.

The use of rumble strips on State highways requires approval by the District Traffic Engineer. Requests should include a description of location,

reasons for use, the alternatives which were considered, collision history and a discussion of standard traffic control devices which have been or are in place.

1. TRAVELED WAY RUMBLE STRIPS

Rumble strips on the traveled way are 19 mm or less in height if raised, 25 mm or less in depth if rolled in indentations, 8.5 mm +/- 1.5 mm if ground in indentations and generally extend across the travel lanes.

There are several significant disadvantages to the use of rumble strips across the travel lanes. These include:

- An abrupt rise or depression in the roadway can present problems to bicyclists and motorcyclists. For this reason, there should be provisions made for cyclists to safely traverse through or around rumble strips or to use rumble strips which have been tested and demonstrated to be "bicycle friendly".
- Nearby residents may be subjected to continuous noise and vibration in residential areas prompting citizen's complaints.
- All motorists are subjected to the noise and vibration whereas only a few are in need of this effect to be alerted.
- Motorists may make unusual maneuvers to avoid rumble strips.

Typical locations where rumble strips on the traveled way have been used include:

- End of a freeway.
- In advance of toll booths.

- Within a construction zone in advance of the workers.
- In advance of a "T" Intersection where the motorist is not expecting to stop.

2. SHOULDER RUMBLE STRIPS

Shoulder rumble strips are 19 mm or less in height if raised, 25 mm or less in depth for rolled in indentations and 8.5 mm +/- 1.5 mm for ground in indentations. The maximum width of shoulder rumble strips is 300 mm for both rolled in and ground in indentations. Typically they should be placed at 150 mm from the edge of traveled way but may be moved to 300 mm to avoid longitudinal joints, paving tapers, etc. Shoulder rumble strips should never be ground or rolled into bridge decks or bridge approach slabs, if rumble strips are to be installed along a segment of highway and are needed across these locations they should be installed using a suitable raised or inverted profile thermoplastic.

Where bicycles are permitted, shoulder rumble strips should not be used unless approximately 1.5 m of clear shoulder width for bicycle use is available between the rumble strips and the outer edge of the shoulder. If shoulder width is less than 1.5 mm and rumble strips are required then only raised and inverted profile thermoplastic stripe shall be used.

Research findings indicate that the use of rumble strips on shoulders of freeways in remote areas may reduce drift-off-road accidents. The rumble strips may consist of grooves rolled into the hot mix as part of a resurfacing project, ground in indentation in Portland Concrete Cement or Asphalt Concrete in existing roadway shoulders, or the application of a raised and inverted profile thermoplastic. When freeways in remote areas are to be resurfaced, consideration should be given to the drift-off-road problem and any related collisions history for the subject roadway and the use of rumble strips considered.

Table 6-1, Rumble Strip Installation Guide, may be used by the District Traffic Engineer to determine the appropriate rumble strip treatment for various shoulder types.

**Table 6-1
RUMBLE STRIP INSTALLATION GUIDE**

RUMBLE STRIP TREATMENT	RUMBLE STRIP DEPTH (mm)	SHOULDER TYPE	BICYCLES PERMITTED	SHOULDER WIDTH
Rolled in Rumble Strip Treatment Standard Plan A40A	25	ACC Only	YES	1.5 meters minimum
			NO	1.2 meters minimum
Ground In Rumble Strip Treatment Standard Plan A40B	8 (+/- 1.5)	ACC and PCC	YES	1.5 meters minimum
			NO	1.2 meters minimum
Raised and Inverted Profile Thermoplastic	N/A	ACC and PCC	YES	No minimum
			NO	No minimum
Centerline Ground In Rumble Strip Treatment Experimental	8 (+/- 1.5)	ACC and PCC	N/A	N/A

NOTE: Ground In Rumble Strip Treatments that are greater than 8.5 mm +/- 1.5 mm in depth shall not be installed on shoulders where bicyclists are allowed.

6-03.3 Contrast Treatment

Contrast treatment of the pavement surface may be used to reduce motorist confusion where surface texture changes in transition areas, such as from concrete to asphalt.

Contrast treatment should be placed to provide square endings across the traffic lanes to avoid the feathering out that may lead a motorist out of the proper traffic lane.

This treatment may be used for roadways, auxiliary lanes, exit ramps and other locations

6-03.4 Location Markers - Fire Hydrants

Blue raised reflective pavement markers, although not an official traffic control device, may be placed on a highway, street, or road, to mark fire hydrant and/or water supply locations. They shall not be used for any other purpose.

Local agencies shall not place blue reflective pavement markers on a State highway unless they first obtain an encroachment permit from the

Department of Transportation. The agency responsible for the placement will also be responsible for the maintenance and replacement. See Section 13060, of the Health and Safety Code.

In general, the blue reflective pavement markers should be placed 150 mm from the centerline stripe, or approximate center of the pavement where there is no centerline stripe, on the side nearest the fire hydrant.

When placed on expressways, freeways and freeway ramps, they should be placed on the shoulder, 0.31 m to the right of the edgeline, opposite the fire hydrant. Typical marker locations are shown on Figure 6-44, TYPICAL FIRE HYDRANT LOCATION PAVEMENT MARKERS.

Because fire hydrants adjacent to freeways may be out of the right-of-way and, in many locations, out of view from the freeway, some fire districts may want to install small supplemental signs or markings to identify the hydrant number or distance to the hydrant. These installations are optional and at the discretion of the District Division Chief for Operations.

Delineators 6-04

6-04.1 Introduction

Delineators are retroreflective devices mounted at the side of the roadway, in series, to indicate the roadway alignment. Delineators are effective aids for night driving and under other conditions of reduced visibility. They are devices to guide rather than warn. Delineators may be used on long continuous sections of highway or through short stretches where there are changes in horizontal alignment, particularly where the alignment might

be confusing, or at pavement width transitions. An important advantage of delineators is that they remain visible when the roadway is wet or snow covered.

Delineators are normally placed in the ground outside of the edge of pavement. Where delineation is required within a paved area, surface mounted channelizers may be used. See Section 6-06, CHANNELIZERS.

Installations should be inspected at night to ensure that there are no confusing or misleading delineators.

6-04.2 Delineator Design

Delineators shall consist of retroreflector units capable of clearly reflecting light under normal atmospheric conditions from a distance of 300 m when illuminated by the upper beam of standard automobile lights. The size of retroreflector units shall be a minimum of 75 mm x 300 mm for the front, and when applicable, 75 mm x 75 mm for the back.

There are two classes of delineator posts and several types of retroreflectorization as shown in Figure 6-45, TYPICAL DELINEATORS.

6-04.3 Delineator Application

Delineation is intended to be a clear and simple guide to the motorist regarding alignment of the highway.

The color of the delineator retroreflectors shall conform to the color of edgelines except for the use of yellow on the right at narrow bridges and red at truck escape ramps.

Examples of the use of delineators are shown in Figure 6-45, TYPICAL DELINEATORS. Color exceptions, are shown in Figure 6-48, NARROW BRIDGE SIGNING AND MARKINGS and Figure 6-49, TYPICAL RUNAWAY TRUCK RAMP SIGNING AND MARKINGS.

TYPICAL DELINEATORS AND USES:

- Type E - White Retroreflector (2 Sided). For use on the left or right of 2-lane 2-way streets and highways when it is desirable to have a reflector on the front, and one on the back of the delineator facing the opposite direction of traffic.
- Type F - White Retroreflector (1 Sided). For use on the right of freeways and expressways. They may also be used on 2-lane 2-way streets and highways when the Type E is not needed.
- Type G - Yellow Retroreflector (1 Sided). For use on the left of divided highways and 2-lane highway intersections as shown in Figure 6-46, TYPICAL EXAMPLES OF DELINEATOR PLACEMENT WHEN USED AT INTERSECTIONS, ISLANDS, RAMPS AND CONNECTORS.
- Type I - Yellow Retroreflector (2 Sided). For use at approaches to narrow bridges as shown in Figure 6-48, NARROW BRIDGE SIGNING AND MARKINGS.
- Type J - Red Retroreflector (1 Sided). For placement on both sides of Truck Escape Ramps as shown in Figure 6-49, TYPICAL RUNAWAY TRUCK RAMP SIGNING AND MARKINGS.

Delineators with the appropriate retroreflector color are used to indicate the narrowing of the pavement where either an outside or inside lane merges into an adjacent lane. The delineators should be used adjacent to the lane affected for the full length of the convergence and should be so placed and spaced to show the width reduction as shown in Figure 6-15, TYPICAL LANE REDUCTION TRANSITION.

6-04.4 Delineator Placement and Spacing

Delineators, when used, shall be mounted so that the top of the retroreflector is about 1.2 m above the edge of traveled way. They shall be placed 0.61 to 1.83 m outside the outer edge of the shoulder, or if appropriate, in the line with the guardrail post.

Delineators should be placed at a constant distance from the edge of the roadway except that, where a guardrail or other obstruction intrudes into the space between the pavement edge and the extension of the line of delineators, the delineators should be in line with or taper to inside the innermost edge of the obstruction. See Figure 6-45, TYPICAL DELINEATORS.

Unless local conditions justify otherwise, delineators shall be placed on all State highways and should be provided on all city and county roads as follows:

- a. On the outsides of highway curves of 914 m radius or less (including medians in divided highways), freeway exit and entrance ramps and connectors. Exception to this, is where a median barrier is delineated as shown in the Median Barrier Delineation Detail in Figure 6-50, TYPICAL MEDIAN BARRIER DELINEATION AND CHANNELIZERS. Delineator spacing on curves is shown in Figure 6-47, DELINEATOR SPACING ON CURVES.
- b. On the right of tangent sections of freeway entrance and exit ramps, collector roads, freeway connectors and lane reduction transition sections at 60 m spacing.
- c. On embankments higher than 3.0 m and with side slopes steeper than 1:4. Delineator spacing is approximately 160 m.
- d. On approaches to narrow bridges as shown in Figure 6-48, NARROW BRIDGE SIGNING AND MARKINGS.

- e. On tangent sections of rural State highways where there are no reflective pavement markers, such as in snow areas. Delineator spacing is approximately 160 m.
- f. On all new guardrail or bridgerail installations, or when maintenance is required on existing guardrail or bridgerail, within 3.66 m of the edge of traveled way and curves of 900 m radius or less. The spacing on tangent sections is approximately 160 m. For spacing on curves, see Figure 6-47, DELINEATOR SPACING ON CURVES.

Delineators may also be placed as follows:

- a. At intersections, road approaches, and median openings, as shown in Figure 6-46, TYPICAL EXAMPLES OF DELINEATOR PLACEMENT WHEN USED AT INTERSECTIONS, ISLANDS, RAMPS AND CONNECTORS.
- b. On sections of highway with non-standard shoulder width.

Where normal uniform spacing is interrupted by driveways, intersections, etc., delineators may be moved a distance not exceeding 1/4 of the normal spacing. If they still fall within such areas, the delineator should be eliminated.

Delineator spacing should be adjusted on approaches to and throughout horizontal curves so that several are always visible to the motorist. On short radius curves, it may be necessary to adjust the delineator several degrees toward the roadway so that it is perpendicular to the line of oncoming traffic.